

## A Rare Segmental Fracture of The Clavicle in a Cyclist: Case Report and Review of Cyclist-Related Fractures

Anestis Iossifidis<sup>1</sup>, Georgios Papadakis<sup>2</sup>, Nicholas Iossifidis<sup>3</sup>

1 Department of Trauma and Orthopaedic Surgery, Croydon University Hospital, London, UK;

2 Chalkida Hospital, Greece;

3 Goldsmiths University of London, UK.

**Conflict-of-interest statement:** The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

**Open-Access:** This article is an open-access article which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Correspondence to:** Anestis Iossifidis, MD, FRCS Ed, FRCS Ed (orth.) Senior Orthopaedic Surgeon, Head of Shoulder & Upper limb Unit, Croydon University Hospital, 530 London Road, Croydon, London, CR7 7YE.

Email: [anestis.iossifidis@gmail.com](mailto:anestis.iossifidis@gmail.com)

Telephone: +0044 (0) 7802404708

Received: June 11, 2022

Revised: June 26, 2022

Accepted: June 29 2022

Published online: August 28, 2022

### ABSTRACT

The number of pedal cyclists seriously injured has increased by 11% between 2009 and 2019 in Great Britain. Bicycle-related trauma remains a public health concern as the number of admitted bicycle injuries is increasing. We present a rare case of a segmental fracture of the clavicle associated with a LeFort midfacial fracture in a female cyclist. We review the literature and discuss the epidemiology, associated injuries and long-term morbidity of cycling-related fractures.

**Key words:** Cyclist fractures; Segmental fracture; Clavicle fractures; Midfacial fracture; Cyclist injuries

© 2022 The Author(s). Published by ACT Publishing Group Ltd. All rights reserved.

Iossifidis A, Papadakis G, Iossifidis N. A Rare Segmental Fracture of The Clavicle in a Cyclist: Case Report and Review of Cyclist-Related Fractures. *International Journal of Orthopaedics* 2022; 9(4): 1685-1688 Available from: URL: <http://www.ghrnet.org/index.php/ijo/article/view/3336>

### INTRODUCTION

There has been an increase in pedal cyclist traffic in Great Britain of 17% from 2009 to 2019 (2.8 to 3.3 billion vehicle miles). The number of pedal cyclists seriously injured has also increased by 11% between 2009 (3,689 cases) to 2019 (4,092 cases)<sup>[1]</sup>.

Bicycle-related trauma remains a public health concern as the number of admitted bicycle injuries is increasing. In a recent UK study of patients admitted to a large trauma centre for cycling-related injuries, 40% sustained orthopaedic fractures and of those 58.5% required surgical treatment. A road traffic accident was the main cause in 39% of cases. The clavicle was the most common fracture in 30% of upper limb fractures and 16.4% of all fractures<sup>[2]</sup>.

Fractures of the clavicle usually occur at the midshaft in 69% of cases<sup>[3]</sup>. A segmental fracture however, with fractures both of the midshaft and the lateral end of the clavicle is a very rare combination with an incidence of 0.5%<sup>[4]</sup>.

We present a case of this uncommon segmental fracture of the clavicle associated with a LeFort type I midfacial fracture in a female cyclist. We review the literature and discuss the epidemiology and long-term morbidity of cycling-related fractures.

### CASE REPORT

A 31-year-old female road cyclist wearing a helmet was involved in a road traffic accident during day time commuting. The cyclist was hit from the left side vertically by an incoming motor vehicle travelling at a speed of 15 miles/hour. Following the collision and impact on the road, due to the obvious facial and clavicle fractures, the cyclist was transferred by ambulance to the nearest hospital. There was no initial loss of consciousness. Imaging studies excluded brain or skull injuries and showed a right displaced segmental fracture of the clavicle (Figure 1), and a right displaced unilateral LeFort type

I midfacial fracture (Figure 2). Surgical fixation of the midfacial fracture with restoration of occlusion was performed as an emergency the same day (Figure 3). Open reduction and internal fixation of the segmental fracture of the clavicle with an S 7-hole plate was performed 48 hours later (Figure 4). The patient made an uneventful recovery and was discharge the following day. At six months follow-up there was an 80% functional recovery due to residual shoulder stiffness. In view of further improvement with physiotherapy over the following 3 months the patient was happy to be discharged.

## DISCUSSION

Fractures of the clavicle account for 2.6% to 3.3% of adult fractures and 44% of injuries to the shoulder girdle<sup>[3,5-6]</sup>. The reported incidence is between 24.4 and 29 per 100,000 person-years<sup>[3,7-8]</sup>. Fractures of the midshaft of the clavicle are the most common in 62 % to 81% of cases. Fractures of the lateral-end occur in 16% to 30% and the medial end in 1.2% to 4% of cases<sup>[3,5,9-10]</sup>. However, the association of a fracture of the midshaft and of the lateral end of the clavicle is a very rare type of segmental fracture (0.5%)<sup>[4]</sup>. Only 4 previous cases of this particular fracture combination in adults have been reported in the literature<sup>[11-14]</sup>. Three of these cases were associated with rib fractures<sup>[11-13]</sup>, and high energy impact was the common mechanism of injury in all cases. In our case report the segmental fracture was associated with a mid-facial fracture as a result of a road traffic accident.

### Cyclists and clavicular fractures

Among the transport accidents reported in the literature, cycling accidents are by far the most common cause of clavicular fracture, varying between 16.4% to 32% of cases<sup>[2,8-10,15-16]</sup>. Jamil *et al*<sup>[2]</sup> (2021) in a study of 737 patients admitted for cycling-related injuries between 2012 and 2020, reported that 40% sustained orthopaedic fractures and of those, 58.5% required surgical treatment. A road traffic accident was the main cause in 39% of cases. Upper limb fractures were seen in 41.4%, lower limb in 34% and pelvis in 25% of cases. The clavicle was the most common fracture in 30% of upper limb fractures and 16.4% of all fractures.

It is important to note that clavicular fractures in high energy trauma are associated with high morbidity. In a study of 411,612 clavicular fractures in the United States over a period of 12 years (2001-2013), Amer *et al*<sup>[17]</sup> (2020) reported a high incidence of associated injuries. These included thoracic injury in 41%, spine injury in 15.3%, skull fractures in 9%, concussion in 8.4%, facial injuries in 7%, and splenic injury in 4.3% of cases, with an overall mortality of 2.9%.

### Cyclists and Facial fractures

In this report the patient sustained an uncommon facial fracture classified as a LeFort type I. This type of fracture is located in the horizontal plane inferior to the maxillary sinus and inferior orbital rim, but superior to the teeth. Displacement of the maxilla is more likely when the fracture extends beyond both the medial and lateral maxillary buttresses. The three types of these injuries were first classified in 1901 by Rene LeFort. The classification was based on a low-velocity impact. Currently, however, LeFort fractures are predominately caused by motor vehicle accidents or other high-energy collisions<sup>[18]</sup>.

LeFort type I injuries are uncommon. Boffano *et al*<sup>[19]</sup> (2013) reported that the incidence of bicycle-related facial fractures among all maxillofacial injuries was 8.8%. This study included 208 patients with

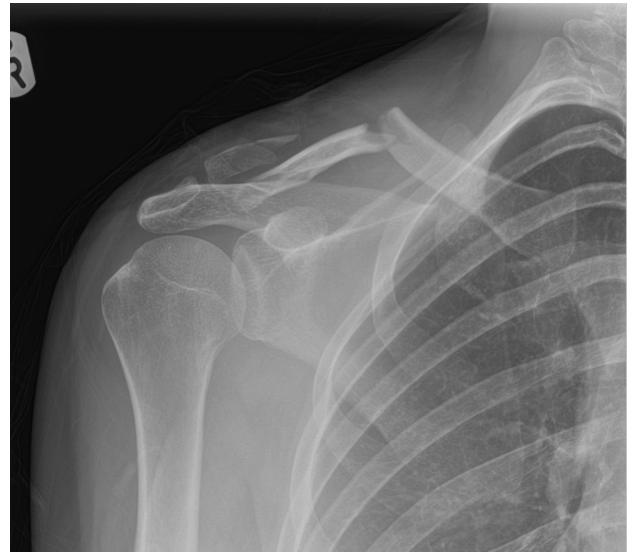


Figure 1 Segmental fracture of the right clavicle. Fracture at the midshaft associated with a fracture of the lateral end of the clavicle.

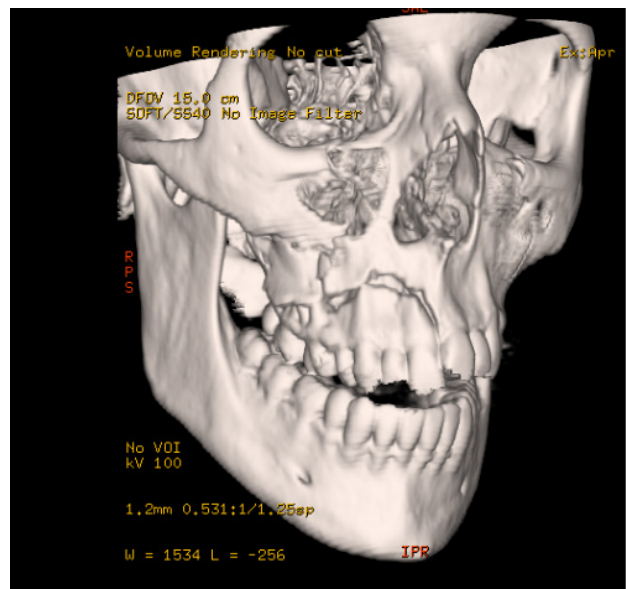


Figure 2 Displaced Unilateral LeFort type I fracture.

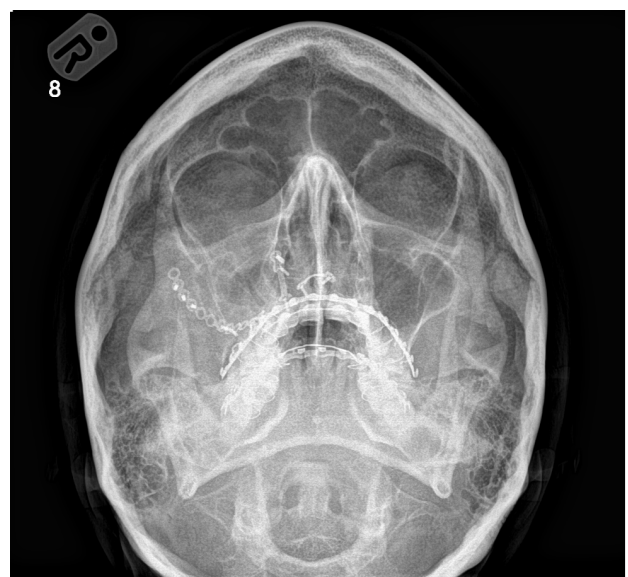
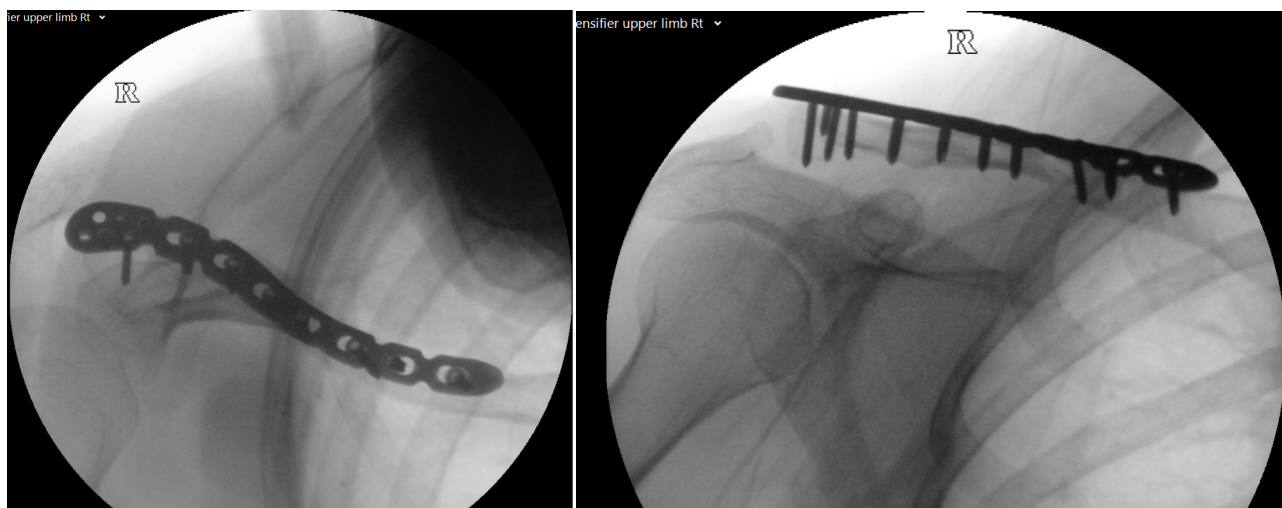


Figure 3 Internal fixation of LeFort midfacial fracture.



**Figure 4** Open reduction and internal fixation with 7-hole locking compression plate.

a male to female ratio of 3:1, and a mean age of 39. The most common fractures involved the mandible (36.2% to 57.8%), and the zygoma (27% to 35.2%). LeFort type I fractures accounted for 2.9% of cases.

Sorenson *et al.*<sup>[20]</sup> (2021) in a study of 138,078 patients injured due to cycling trauma during a period 10 years (2010 to 2019), reported a 10.4% (14,326) prevalence of facial injury. Thirteen percent of facial injuries were fractures.

Facial protection is therefore paramount. Several studies have reported that cycling helmets can substantially reduce craniofacial injuries. Benjamin *et al.*<sup>[21]</sup> (2019) in 85,187 cycling-related facial injuries over 5 years (2010-2014), reported a prevalence of 11.6% head fractures and 11.3% facial fractures. Helmets reduced head fractures by 52% (from 14.0% to 7.3%), while the reduction in facial fractures was 35% for upper face, 28% for mid face, and 21% for the lower face.

Three recent meta-analyses have also showed that bicycle helmets are protective against facial injuries<sup>[22-24]</sup>. Oliver *et al.*<sup>[22]</sup> (2017) reported that helmets were associated with a reduced odds of head injury and facial injury (odds ratios of 0.49 and 0.67 respectively). Fitzpatrick *et al.*<sup>[23]</sup> (2018) showed that helmets were protective against facial fracture with an odd ratio of 0.79. In addition, Høyevang *et al.*<sup>[24]</sup> (2018) found that the use of bicycle helmets reduced head injury by 48%, serious head injury by 60%, traumatic brain injury by 53%, face injury by 23%, and the total number of killed or seriously injured cyclists by 34%.

It is noteworthy that long term morbidity of cycle-related injuries is underestimated. However, Zibung *et al.*<sup>[25]</sup> (2016) reported that more than 70% of bicycle trauma patients still suffered from pain or other physical symptoms more than six months after their bicycle crash even though only 15% were severely injured. Patients with a Glasgow Coma Scale (GCS)  $\leq$  13 or an Injury Severity Score (ISS)  $>$ 15 experienced impaired emotions / outlook on life. Physical suffering was reported by patients with a GCS  $\leq$  13 and in those with injuries to the cervical spine. Patients with an ISS  $>$ 15 or facial fractures experienced limitations in daily activities.

## CONCLUSION

Bicycle-related trauma remains a public health concern as the number of pedal cyclists and subsequent hospital admissions for bicycle injuries is rising annually.

Cycling injuries can be devastating due to the severity of associated injuries, mortality and morbidity rates, and impairment of the quality

of life after bicycle trauma. It is therefore paramount to increase public awareness. There is also a need to mitigate the risks of cycling accidents by promoting driver and cyclist education, increasing road safety and improving cyclist protection equipment.

## REFERENCES

1. Reported road casualties Great Britain, provisional results: 2019 Report. Available at <https://www.gov.uk/government/statistics/reported-road-casualties-great-britain-provisional-results-2019>
2. Jamil O, Al Shdefat S, Arshad Z, Thahir A, Anwar F, Davies B, Chou DT. Cycling-related orthopaedic fractures admitted to the Major Trauma Centre in the cycling capital of the UK. *Arch Orthop Trauma Surg.* 2021 Aug 3; 1-7. [PMID: 34345936]; [PMCID: PMC8330467]; [DOI: 10.1007/s00402-021-04097-3]
3. Robinson CM. Fractures of the clavicle in the adult. Epidemiology and classification. *J Bone Joint Surg Br.* 1998; **80**: 476-84. [PMID: 9619941]; [DOI: 10.1302/0301-620x.80b3.8079]
4. Throckmorton T, Kuhn JE. Fractures of the medial end of the clavicle. *J Shoulder Elbow Surg.* 2007; **16**(1): 49-54. [PMID: 17169583]; [DOI: 10.1016/j.jse.2006.05.010]
5. Postacchini F, Gumina S, De Santis P, Albo F. Epidemiology of clavicle fractures. *J Shoulder Elbow Surg.* 2002; **11**: 452-6. [PMID: 12378163]; [DOI: 10.1067/mse.2002.126613]
6. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. *Injury* 2006; **37**: 691-7. [PMID: 16814787]; [DOI: 10.1016/j.injury.2006.04.130]
7. Van Tassel D, Owens BD, Pointer L, Moriatis Wolf J. Incidence of Clavicle Fractures in Sports: Analysis of the NEISS Database. *Int J Sports Med* 2014; **35**: 83-86. [PMID: 23771828]; [DOI: 10.1055/s-0033-1345127]
8. DeFroda SF, Lemme N, Kleiner J, Gil J, Owens BD. Incidence and mechanism of injury of clavicle fractures in NEIS database: athletic and non-athletic injuries. *J Clin Orthop Trauma* Sep-Oct 2019; **10**(5): 954-958. [PMID: 31528074]; [PMCID: PMC6738494]; [DOI: 10.1016/j.jcot.2019.01.019]
9. Herteleer M, Winckelmans T, Hoekstra H, Nijs S. Epidemiology of clavicle fractures in a level 1 trauma center in Belgium. *Eur J Trauma Emerg Surg.* 2018; **44**(5): 717-26. [PMID: 29027569]; [DOI: 10.1007/s00068-017-0858-7]
10. Kihlstrom C, Moller M, Lonn K, Wolf O. Clavicle fractures: epidemiology, classification and treatment of 2422 fractures in the Swedish Fracture Register; an observational study. *BMC Musculoskelet Disord.* 2017; **18**(1): 82. [PMID: 28202071]; [PMCID: PMC5312264]; [DOI: 10.1186/s12891-017-1444-1]
11. Hagino T, Ono T, Hamada Y. Unusual double clavicle frac-

- ture complicated by ipsilateral scapular neck fracture. *J Orthop Sci* 2002; **7**: 417-9. [PMID: 12077674]; [DOI: 10.1007/s007760200072]
12. Osman N, Sinopidis C, Gibson L. Unusual segmental fracture of clavicle associated with rib fractures and pneumothorax. *J Orthop Surg*. 2010; **15**(2): 1-5. Available at <https://print.ispub.com/api/0/ispub-article/5226>
  13. Grossi EA. Segmental clavicle fracture. *Rev Bras Ortop*. 2011; **46**(6): 733-35. [PMID: 27047835]; [PMCID: PMC4799335]; [DOI: 10.1016/S2255-4971(15)30334-7]
  14. Rao AS, Raju LVS N, Banda NK. Segmental clavicle fracture with acromioclavicular joint disruption: Report of a rare case. *J Med Sci Res*. 2020; **8**(1): 25-28. [DOI: 10.17727/JMSR.2020/8-4]
  15. JEM van Laarhoven J, Ferree S, Houwert RM, Hietbrink F, EgbertJan MM, Verleisdonk EJMM, Leenen LPH. Demographics of the injury pattern in severely injured patients with an associated clavicle fracture: a retrospective observational cohort study. *World J Emerg Surg*. 2013; **8**(1): 36. [PMID: 24053405]; [PMCID: PMC3848948]; [DOI: 10.1186/1749-7922-8-36]
  16. Goldstein Y, Oleg Dolkart O, Kaufman E, Amar E, Sharfman ZT, Rath E, Gand M, Eran Maman E. Bicycle-Related Shoulder Injuries: Etiology and the Need for Protective Gear. *Isr Med Assoc J*. 2016; **18**(1): 23-6. [PMID: 26964275]
  17. Amer KM, Congiusta DV, Suri P, Choudhry A, Otero K, Adams M. Clavicle fractures: Associated trauma and morbidity. *J Clin Orthop Trauma*. 2020; **13**: 53-56. [PMID: 33717875]; [PMCID: PMC7919969]; [DOI: 10.1016/j.jcot.2020.08.020]
  18. Louis M, Agrawal N, Truong T. Midface fractures II. *Semin Plast Surg* 2017; **31**(2): 94-99. [PMID: 28496389]; [PMCID: PMC5423797]; [DOI: 10.1055/s-0037-1601373]
  19. Boffano P, Roccia F, Gallesio C, Karagozoglu KH, Forouzanfar T. Bicycle-related maxillofacial injuries: a double-center study. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013; **116**: 275-80. [PMID: 23663988]; [DOI: 10.1016/j.oooo.2013.03.004]
  20. Sorenson TJ, Borad V, Schubert W. Facial injuries due to cycling are prevalent: improved helmet design offering facial protection is recommended. *J Oral Maxillofac Surg*. 2021; **79**(8): 1731.e1-1731.e8. [PMID: 33939961]; [DOI: 10.1016/j.joms.2021.03.013]
  21. Benjamin T, Hills NK, Knott PD, Murr AH, Seth R: Association between conventional bicycle helmet use and facial injuries after bicycle crashes. *JAMA Otolaryngol Head Neck Surg*. 2019; **145**(2): 140-145. [PMID: 30543361]; [PMCID: PMC6440218]; [DOI: 10.1001/jamaoto.2018.3351]
  22. Olivier J, Creighton P: Bicycle injuries and helmet use: A systematic review and meta-analysis. *Int J Epidemiol*. 2017; **46**(1): 278-292. [PMID: 27450862]; [DOI: 10.1093/ije/dyw153]
  23. Fitzpatrick DG, Goh M, Howlett DC, Williams M. Bicycle helmets are protective against facial injuries, including facial fractures: a meta-analysis. *Int J Oral Maxillofac Surg* 2018; **47**(9): 1121-1125. [PMID: 29622478]; [DOI: 10.1016/j.ijom.2018.03.005]
  24. Hoyer A. Bicycle helmets - To wear or not to wear? A meta-analysis of the effects of bicycle helmets on injuries. *Accid Anal Prev*. 2018; **117**: 85-97. [PMID: 29677686]; [DOI: 10.1016/j.aap.2018.03.026]
  25. Zibung E, Riddez L, Nordenvall C. Impaired quality of life after bicycle trauma. *Injury* 2016; **47**: 1078-82. [PMID: 26653265]; [DOI: 10.1016/j.injury.2015.11.015]